Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/239
UNITED STATES
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

IRRADIATION BEHAVIOR OF METALLIC FUELS

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Alloys containing uranium, plutonium, and thorium have been investigated extensively in order to develop metallic fuels with improved properties under irradiation. Several fuel alloy systems have been developed which show excellent dimensional stability under irradiation. Anisotropic irradiation growth of alpha uranium can be virtually eliminated by addition of alloying elements such as molybdenum, niobium, and zirconium. A suitable heat treatment, usually consisting of an extended anneal just below the upper temperature limit of the alpha phase, is required if the material has been fabricated with a preferred grain orientation.

High temperature swelling in uranium fuels can be reduced by alloying additions, again often in connection with a suitable heat treatment to produce an optimum form of microstructure. Swelling in metastable gamma phase alloys in some cases is less dependent upon the phases present before irradiation, but at temperatures below the stable gamma phase the amount of swelling appears to be significantly influenced by fission rate. Swelling in metallic fuels can also be minimized through use of cladding restraint. For example, cladding thicknesses on the order of 0.25 mm have been found to be capable of raising the allowable operating temperatures and achievable burnups in uranium-